Atlantic Richfield Company

Atlantic Richfield Company

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La Palma, CA 90623
Direct: (714) 228-6770

December 4, 2014

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Delivered via e-mail

Subject: November 2014 Monthly Progress Report
Rico-Argentine Mine Site – Rico Tunnels
Operable Unit OU01, Rico, Colorado

Dear Mr. Way,

This progress report describes activities conducted during the month of November, 2014 at the Rico-Argentine Mine Site (site) and activities anticipated to occur during the upcoming month. These activities are organized by task as identified in the Removal Action Work Plan. This progress report is being submitted in accordance with Paragraph 35.a of the Unilateral Administrative Order for Removal Action (the "UAO"), dated March 17, 2011 (effective March 23, 2011).

ACTIVITIES FOR NOVEMBER

This section describes significant developments during the preceding period including actions performed and any problems encountered during this reporting period. A summary of the St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study system performance is provided as an attachment.

Site-Wide Activities

- Demobilized all non-winter equipment and stored remaining materials.
- Cleaned out on-site hot tub discharge water culvert to avoid plugging over the winter months.
- Straightened up access gates and security fencing at the south access points.
- Prepared the winter access routes for winter sampling and monitoring operations.
- Developing site topographic map of existing conditions (central/northern portions of site).

Task A – Pre-Design and Ongoing Site Monitoring

- Performed additional evaluation of potential improvements on surface water flow data gathering and telemetry. Continued working with Town of Rico on the application for an antenna permit.
- Collected data and manual flow measurements from pressure transducers at DR-3 and DR-6.
- Inspected the St. Louis Ponds System, pond water levels, free-board, and condition of high-level outlet pipes and overflow spillways. The pond network appears to be flowing well and in good condition.
- Installed beaver deceivers at DR-6 and the outlet of Pond 15 to mitigate beaver dam blockages.

Task B – Management of Precipitation Solids in the Upper Settling Ponds

- The St. Louis Tunnel discharge was routed to Pond 18 during the month of October, 2014.

- Continued planning for removal of all remaining mining/mineral processing by-products from Upper Ponds.

Task C – Design and Construction of a Solids Repository

- Demobilized all construction machinery/personnel from the site for the duration of the winter. Construction is approximately 50 to 60 percent complete. Construction to be re-started in the spring and completed in 2015. The previous schedule for completion of construction (October 31, 2014) and initial placement of dried pond solids (November 30, 2014) will be adjusted primarily due to unanticipated ground conditions which impacted the volume of fill that could be produced. The need for an adjusted schedule was discussed with Mr. Steve Way during a work progress site walk in September. A request for a formal schedule revision will be prepared and submitted by Atlantic Richfield next month.
- Provided public notice of the December 22, 2014 Dolores County Planning Commission public hearing on the Land Use Application and Engineering Design and Operations Plan (EDOP).
    - Notice sent by mail on November 10, 2014 to all landowners within ½ mile of the Solids Repository.
    - Notice posted in the Dove Creek Press on November 13, 2014 and on November 20, 2014.
    - Notice posted at the intersection of State Highway 145 and the site access road on November 12, 2014.

Task D – Hydraulic Control Measures for the Collapsed Area of St. Louis Tunnel Adit

- Continued design work on Stage 2 for the St. Louis Tunnel hydraulic control system.
- Monitored water levels in the tunnel at AT-2 using the data logger.

Task E – Source Water Investigations and Controls

- Continued Blaine Tunnel water depth and flow monitoring behind the Blaine Coffer Dam and Blaine Tunnel Flume.
- Completed installation of safety fencing and solar panel to provide power to the Blaine Tunnel flume flow data logger through the winter.

Task F – Water Treatment System Analysis and Design

- Continued monitoring activities in accordance with the Performance Monitoring Plan (Appendix B of the St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study Work Plan).
    - Weekly sampling events began on September 16, 2014.
    - Continued operations and maintenance activities.
        - Daily water level measurements
        - Field measurements of select parameters
        - Coagulant injection monitoring
        - Routine maintenance
- Completed winterization of irrigation system for the subsurface flow wetland, including draining all water lines.
- Installed removable snow covers over the aeration cascade. The cover is constructed out of five 10-ft sections of 4 ft diameter corrugated HDPE (black in color) pipe that have been modified to allow placement over the aeration cascade. The purpose of the covers is to prevent the accumulation of snow in the aeration cascade system during the winter months, and allow un-impeded winter month operation by providing a dead-air space insulation layer to assist in preventing the process water in the cascade from freezing.
- Evacuated the contents of the rock drain into Pond 18 to promote the growth of Mn-oxidizing bacteria by removing anoxic standing water and sediment.

- Installed a Campbell Scientific GRWS100 general research-grade weather station east of Settling Basin 02. The station will provide the following measurements:
  - Evaporation
  - Precipitation
  - Temperature
  - Wind Speed/Direction
  - Humidity
  - Barometric Pressure
  - Snow Depth
- Transitioned to winter operations.

ACTIVITIES FOR UPCOMING MONTH

This section describes developments expected to occur during the upcoming reporting period, including a schedule of work to be performed, anticipated problems, and planned resolution of past or anticipated problems.

Site-Wide Activities

- Complete site topographic map of existing conditions (central/northern portions of site).
- Maintain winter access routes for sampling and monitoring of the Demonstration Wetland.
- Conduct winter site access safety training for sampling and monitoring teams.

Task A – Pre-Design and Ongoing Site Monitoring

- Inspect the St. Louis Ponds System, water levels, and free-board.
- Continue work on submittal and processing of the application for a telemetry antenna permit for the Rico office building.

Task B – Management of Precipitation Solids in the Upper Settling Ponds

- Continue routing St. Louis Tunnel discharge to Pond 18.
- Continue planning for removal of all remaining mining/mineral processing by-products from Upper Ponds.

Task C – Design and Construction of a Solids Repository

- Participate in the December 22, 2014 Dolores County Planning Commission public hearing in Dove Creek, Colorado.

Task D – Hydraulic Control Measures for the Collapsed Area of St. Louis Tunnel Adit

- Monitor water levels in the tunnel at AT-2 using the re-installed data logger.

Task E – Source Water Investigations and Controls

- Continue Blaine Tunnel water depth and flow monitoring behind the Blaine Coffer Dam and Blaine Tunnel Flume.

Task F – Water Treatment System Analysis and Design

- Upgrade aeration system with second compressor and additional diffusers.
- Complete Basis for Design of the Enhanced Wetland Demonstration technical memorandum.
- Continue scoping additional data needs as necessary related to treatment system alternatives.

- Continue work on planning and conceptual design of removal of all remaining mining/mineral processing by-products from Upper Ponds and grading/lining of selected Upper Ponds for potential conversion to long-term wetlands or open pond lime addition treatment.
- Continue monitoring activities in accordance with the Performance Monitoring Plan (Appendix B of the St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study Work Plan).

If you have any questions, please feel free to contact me at (951) 265-4277.

Sincerely,

Anthony R. Brown
Project Manager
Atlantic Richfield Company

cc: R. Halsey, Atlantic Richfield
T. Moore, Atlantic Richfield
C. Harris, Atlantic Richfield
S. D'Cruz, Esq., Atlantic Richfield
C. Sanchez, Anderson Engineering
D. Yadon, AECOM
J. Christner, Weston Solutions
S. Riese, EnSci
A. Cohen, Esq., Davis Graham & Stubbs
W. Duffy, Esq., Davis Graham & Stubbs
A. Piggott, Esq., U.S. EPA
D. McCarthy, Copper Environmental
K. Sessions, AEEC
B. Wheeler, AEEC
B. Florentin, AMEC

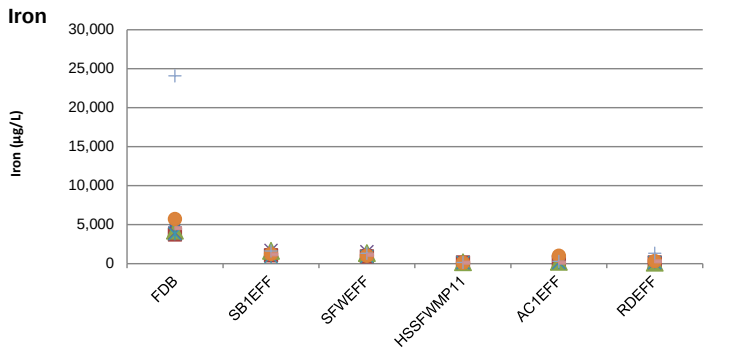
file: Atlantic Richfield Rico Archives, La Palma, CA
AECOM Denver Project File

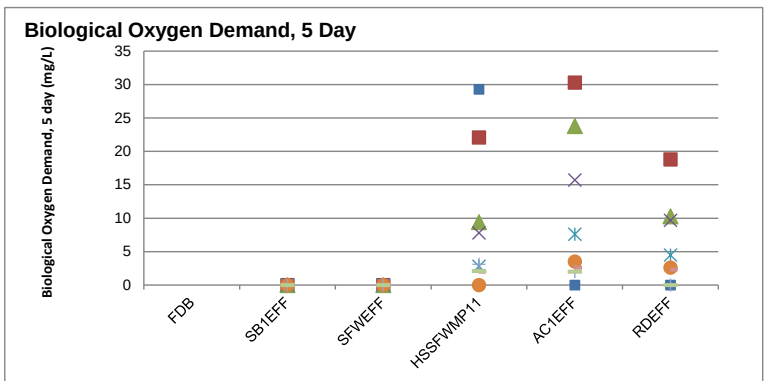
Attachment

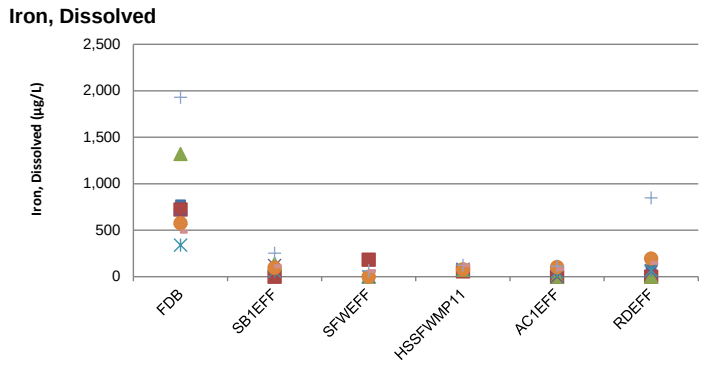
Key Performance Indicators Figures

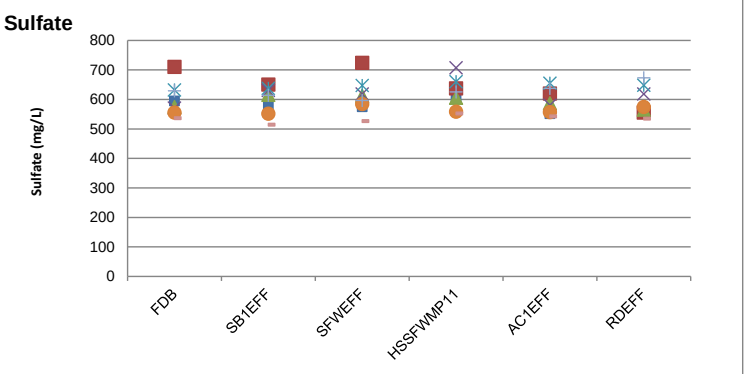
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

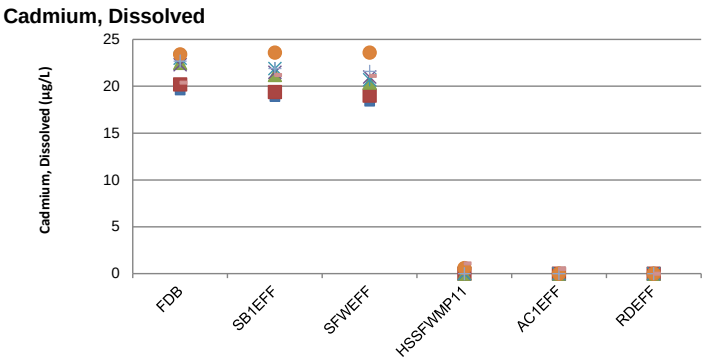
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

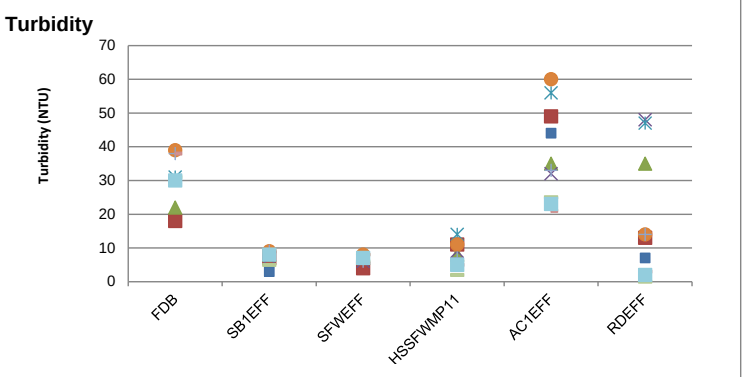


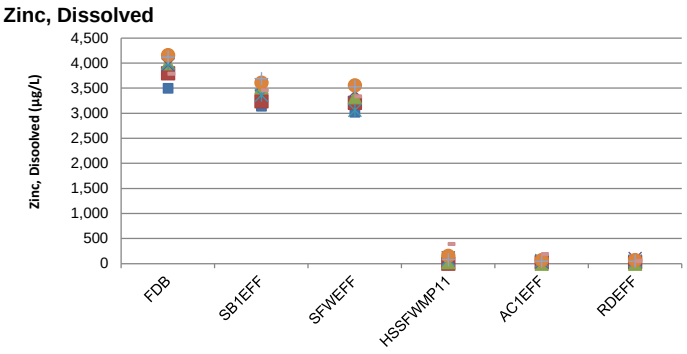


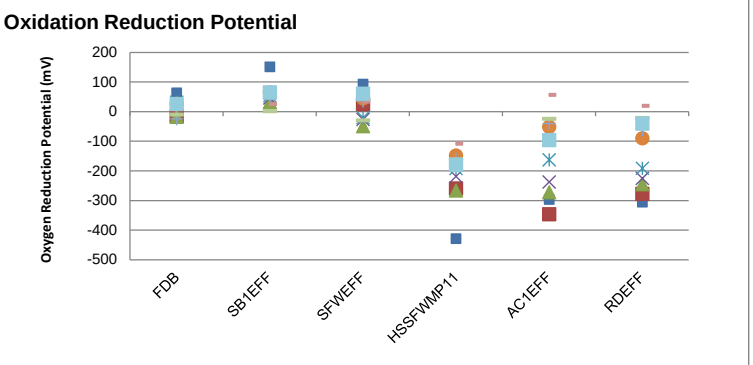


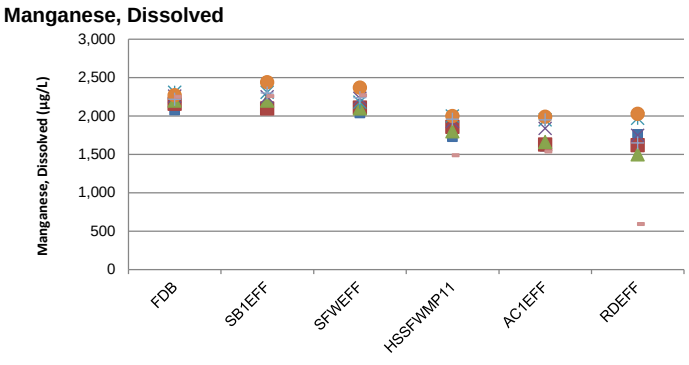


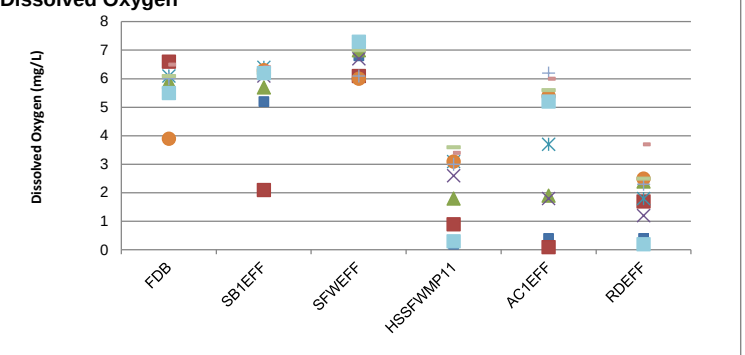


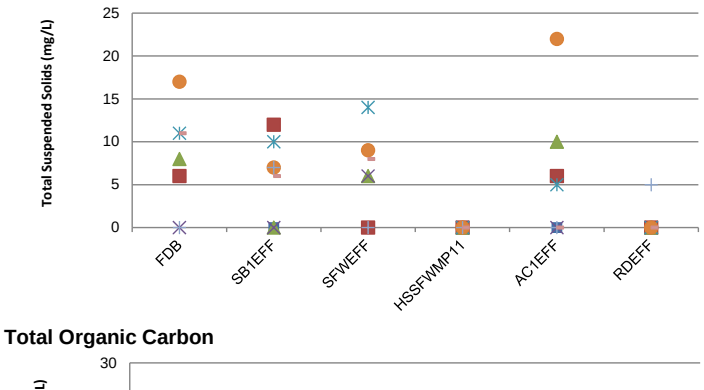


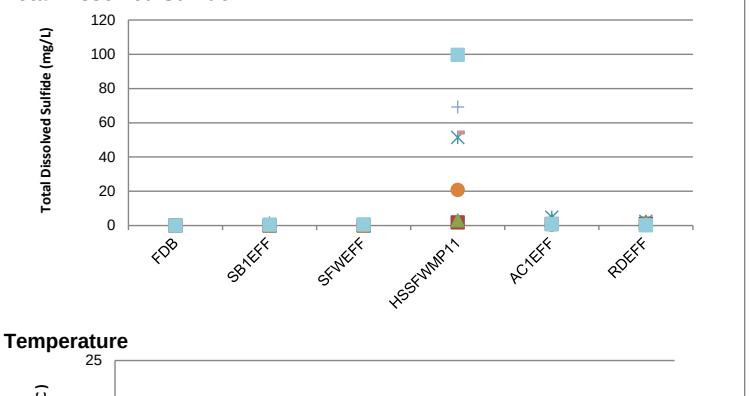


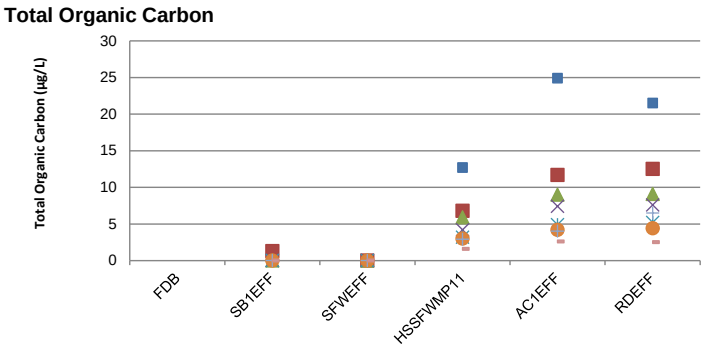


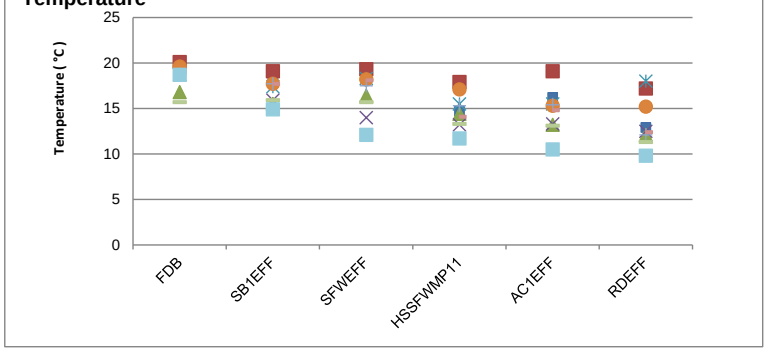












Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC1EFF = Aeration Channel Effluent/Rock Drain Influent
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
RDEFF = Rock Drain Effluent
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

°C = Degrees Celsius
µg/L = micrograms per liter
mg/L = milligrams per liter
mV = millivolts
NTU = Nephelometric Turbidity Units
RL = Reporting Limit
C W** = Colinization Week of Treatability Study Phase

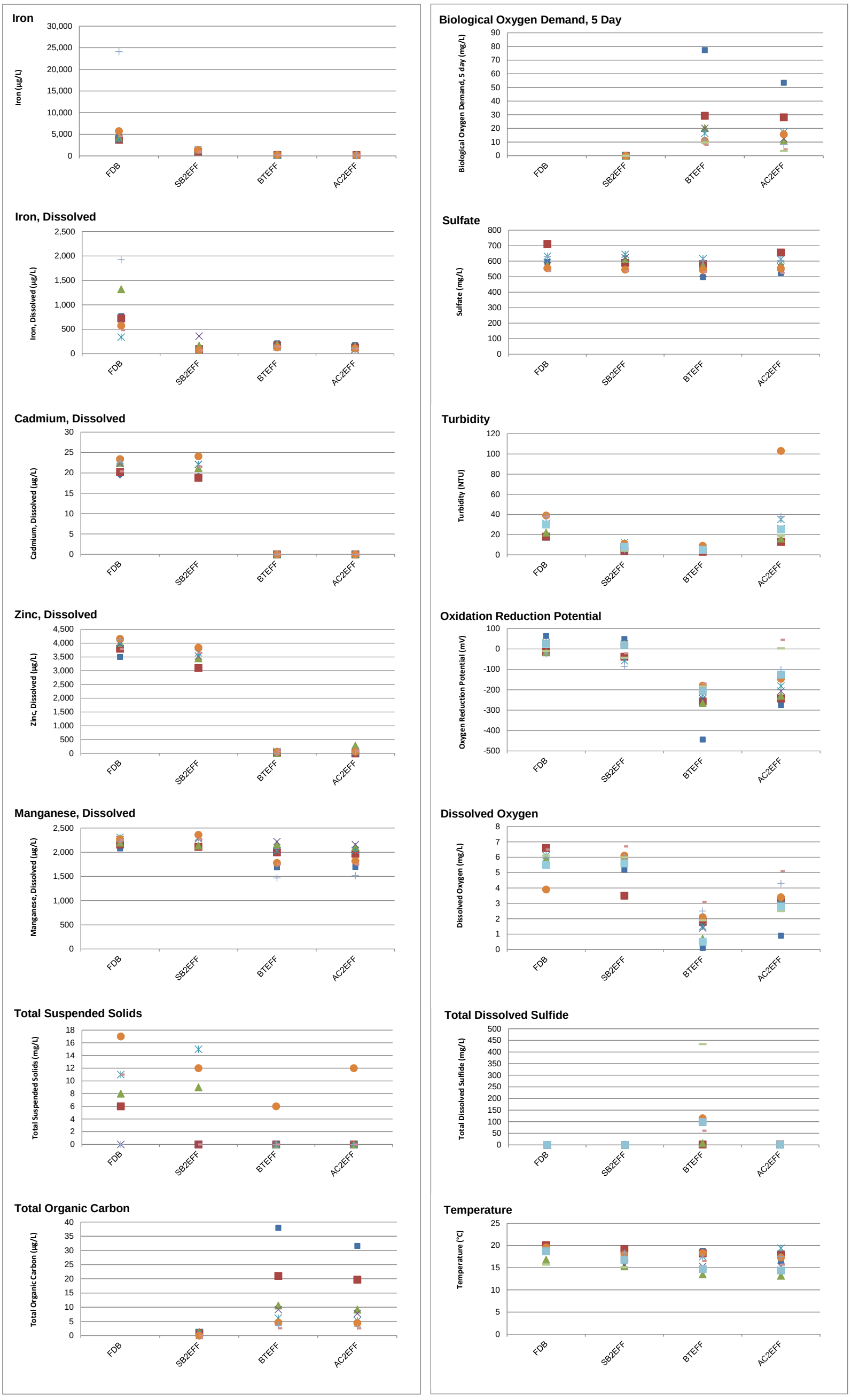
- C W00, 20.3 gpm
- C W01, 27.2 gpm
- C W02, 33.3 gpm
- C W03, 28.2 gpm
- C W04, 27.7 gpm
- C W05, 28.0 gpm
- C W06, 29.3 gpm
- C W07, 29.2 gpm
- C W08, 27.4 gpm
- C W09, 27.4 gpm

FIGURE 1

HWTT Key Performance Indicators Spatial Series

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

12/1/2014



Non detects are reported as less than the laboratory RL and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).
Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

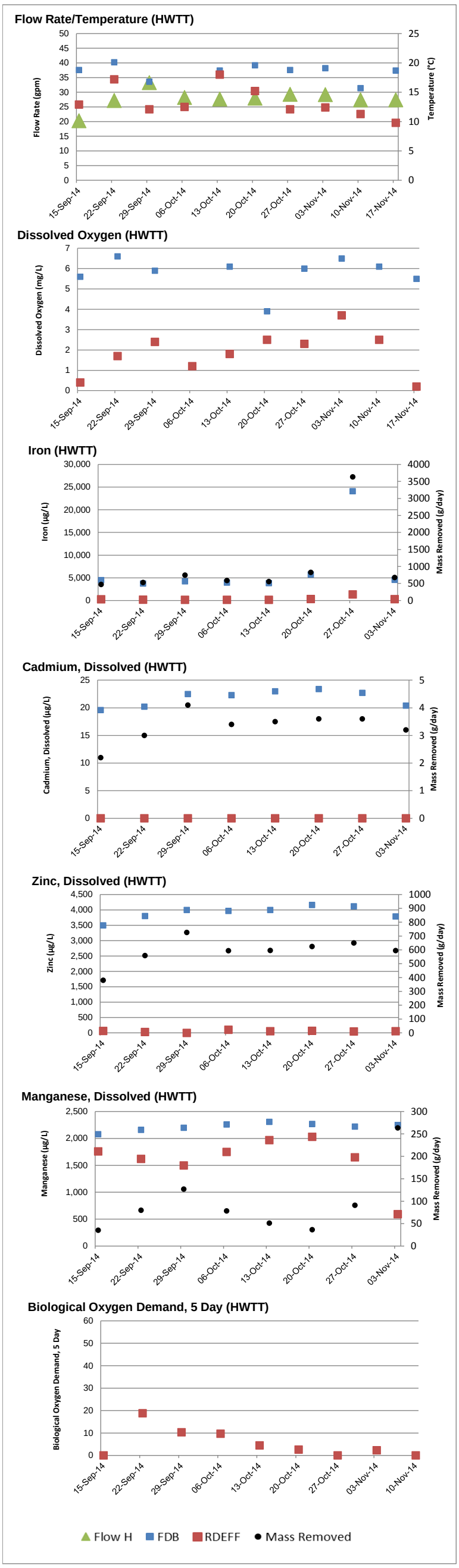
°C = Degrees Celsius
µg/L = micrograms per liter
mg/L = milligrams per liter
mV = millivolts
NTU = Nephelometric Turbidity Units
RL = Reporting Limit
C W** = Colinization Week of Treatability Study Phase

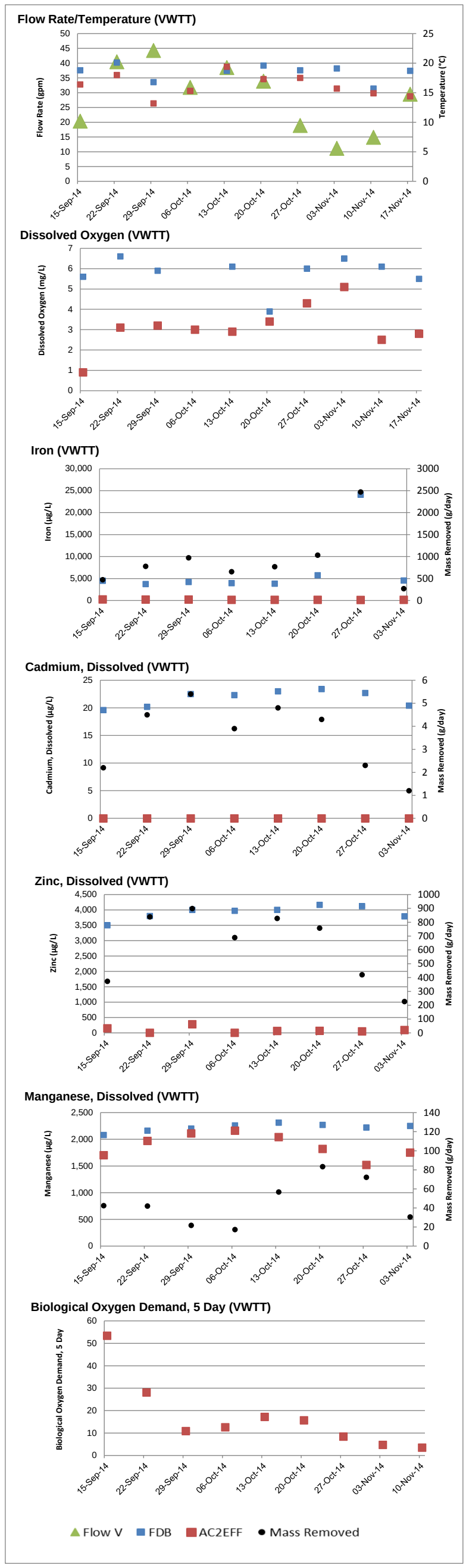
FIGURE 2

VWTT Key Performance Indicators Spatial Series

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

12/1/2014





Non detects are reported as less than the laboratory RL and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).
Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

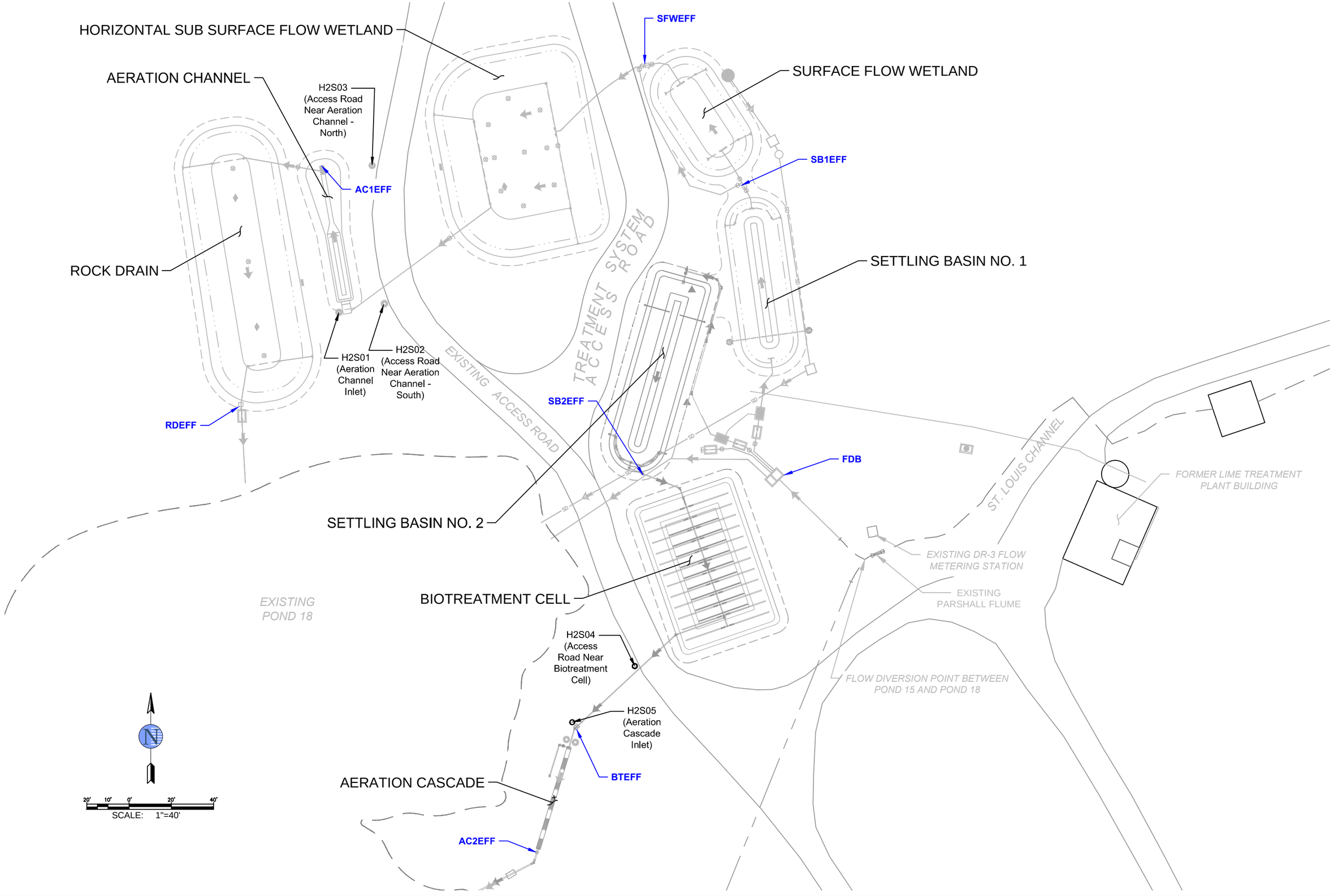
AC2EFF = Aeration Cascade Effluent
°C = Degrees Celsius
µg/L = micrograms per liter
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
gpm = gallons per minute
g/day = grams per day
HWTT = Horizontal Wetland Treatment Train
mg/L = milligrams per liter
mV = millivolts
NTU = Nephelometric Turbidity Units
RDEFF = Rock Drain Effluent
RL = Reporting Limit
VWTT = Vertical Wetland Treatment Train
C W** = Week of Treatability Study Phase

FIGURE 3

HWTT/VWTT Key Performance Indicators Time Series

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

12/1/2014



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CHECKED:	LPCjr
REVIEWED:	KS
APPROVED:	KS
JOB No:	1300
CAD FILE:	Figure 4.dwg

DESCRIPTION | DATE | REV

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

RICO - ARGENTINE MINE SITE
ST LOUIS DISCHARGE CWDTS

Monthly Progress Report
Monitoring Locations

AEEC
www.americanconsultants.com
3489 W 2100 S, Salt Lake City, UT 84119
801-908-5447 Fax 801-972-2741

DATE:	01 DEC 14
SCALE:	1:40
SHEET:	01 OF 01

Figure 4

W:\UT\Projects\1300 BP Rico Task 1-8\8. Reports\Monthly Summary\EPAMonthly\11 November 2014\Natives\Figure 4 Field Sampling.dwg

Key Performance Indicators Tables

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Table 1. Iron (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	4500	1330	1200	223	261	250	1250	266	246
C	W01	22-Sep-14	27.2	40.5	3740	1070	930	168	203	170	971	206	218
C	W02	29-Sep-14	33.3	44.3	4230	1640	1360	194	250	129	1440	216	210
C	W03	06-Oct-14	28.2	31.8	3940	1720	1540	142	156	134	937	171	165
C	W04	13-Oct-14	27.7	38.5	3820	892	900	146	138	144	1500	161	154
C	W05	20-Oct-14	28.0	33.9	5730	1260	1010	133	1010	326	1390	244	143
C	W06	27-Oct-14	29.3	18.9	24100	1630	1330	171	304	1340	R	157	137
C	W07	03-Nov-14	29.2	11.2	4550	1180	1130	126	118	297	902	175	153

NOTES:

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AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = horizontal treatment train average flow rate
Flow V = vertical treatment train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
OU = operable unit
RDEFF = Rock Drain Effluent
R = rejected
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
µg/L = microgram per liter
W** = Week of Treatability Study Phase

Table 2. Iron, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	772	56.4	<50	80.7	50.8	76.2	101	213	174
C	W01	22-Sep-14	27.2	40.5	723	<50	182	56	<50	<50	96.2	172	128
C	W02	29-Sep-14	33.3	44.3	1320	140	<50	74.1	<50	<50	166	189	147
C	W03	06-Oct-14	28.2	31.8	625	120	<50	79.8	<50	53.3	360	147	86.2
C	W04	13-Oct-14	27.7	38.5	339	58.2	<50	77	52.8	66.1	67	135	89.4
C	W05	20-Oct-14	28.0	33.9	575	96	<50	78.9	103	195	72.8	128	106
C	W06	27-Oct-14	29.3	18.9	1930	252	64.6	123	113	847	R	140	113
C	W07	03-Nov-14	29.2	11.2	483	113	59.9	122	80.5	148	66.4	143	106

NOTES:

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AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

µg/L = microgram per liter

W** = Week of Treatability Study Phase

Table 3. Cadmium, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	19.6	18.9	18.4	<0.5	<0.5	<0.5	19.1	<0.5	<0.5
C	W01	22-Sep-14	27.2	40.5	20.2	19.4	19	<0.5	<0.5	<0.5	18.8	<0.5	<0.5
C	W02	29-Sep-14	33.3	44.3	22.5	21.2	20.4	<0.5	<0.5	<0.5	21.2	<0.5	<0.5
C	W03	06-Oct-14	28.2	31.8	22.3	21.5	21	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W04	13-Oct-14	27.7	38.5	23	21.9	20.7	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W05	20-Oct-14	28.0	33.9	23.4	23.6	23.6	0.6	<0.5	<0.5	24.1	<0.5	<0.5
C	W06	27-Oct-14	29.3	18.9	22.7	21.9	21.6	<0.5	<0.5	<0.5	R	<0.5	<0.5
C	W07	03-Nov-14	29.2	11.2	20.4	21.2	21.1	1.1	0.51	<0.5	21.6	<0.5	<0.5

NOTES:

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OU = operable unit
R = rejected
RDEFF = Rock Drain Effluent
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
µg/L = microgram per liter
W** = Week of Treatability Study Phase

Table 4. Zinc, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	3500	3140	3020	60.6	<10	62.5	3120	52 J	148
C	W01	22-Sep-14	27.2	40.5	3800 J	3240	3210	<10	27	30	3100	12.8	<10
C	W02	29-Sep-14	33.3	44.3	4000	3520	3320	30.3	<10	<10	3450 J	10.8	279
C	W03	06-Oct-14	28.2	31.8	3970	3570	3440	115	37.9	102	3530	32.7	<10
C	W04	13-Oct-14	27.7	38.5	4000	3360	3060	90.4	60.5	53	3650	76.2	59.4
C	W05	20-Oct-14	28.0	33.9	4160	3610	3560	156	70	69.3	3840	56.4	65.7
C	W06	27-Oct-14	29.3	18.9	4120	3690	3530	79.9	47.8	47.9	R	<10	46.9
C	W07	03-Nov-14	29.2	11.2	3790	3460	3340	391	190	54	3650	83.3	91.7

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

µg/L = microgram per liter

W** = Week of Treatability Study Phase

Table 5. Manganese, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	2080	2100	2040 J	1730 J	1610	1760	2110	1690	1700
C	W01	22-Sep-14	27.2	40.5	2160 J	2100	2110	1860 J	1630	1620	2110	2000	1970
C	W02	29-Sep-14	33.3	44.3	2200	2200	2100	1800	1660	1500	2140 J	2170 J	2110
C	W03	06-Oct-14	28.2	31.8	2260	2250	2230	1930	1840	1750 J	2280	2220 J	2160
C	W04	13-Oct-14	27.7	38.5	2310 B	2310 B	2180 B	2000 B	1950 B	1970 B	2310 B	2030 B	2040 B
C	W05	20-Oct-14	28	33.9	2270	2440	2370	2000 J	1990	2030	2360	1780	1820
C	W06	27-Oct-14	29.3	18.9	2220	2300	2240	1960	1950	1650 J	R	1470	1520
C	W07	03-Nov-14	29.2	11.2	2250	2260	2270	1490 J	1540	594	2270	1750	1750 J

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

B = Laboratory flag indicating blank contamination

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

µg/L = microgram per liter

W** = Week of Treatability Study Phase

Table 6. Total Suspended Solids (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	6	<5	<5	<5	<5	<5	<5	<5	<5
C	W01	22-Sep-14	27.2	40.5	6	12	<5	<5	6	<5	<5	<5	<5
C	W02	29-Sep-14	33.3	44.3	8	<5	6	<5	10	<5	9	<5	<5
C	W03	06-Oct-14	28.2	31.8	<5	<5	6	<5	<5	<5	<5	<5	<5
C	W04	13-Oct-14	27.7	38.5	11	10	14	<5	5	<5	15	<5	<5
C	W05	20-Oct-14	28.0	33.9	17	7	9	<5	22	<5	12	6	12
C	W06	27-Oct-14	29.3	18.9	<5	7	<5	<5	<5	5	R	<5	<5
C	W07	03-Nov-14	29.2	11.2	11	6	8	<5	<5	<5	<5	<5	<5

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
mg/L = milligram per liter
OU = operable unit
R = rejected
RDEFF = Rock Drain Effluent
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Table 7. Total Organic Carbon (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	NR	<1	<1	12.7	24.9	21.5	<1	38	31.6
C	W01	22-Sep-14	27.2	40.5	NR	1.3	<1	6.8	11.7	12.5	1	21	19.7
C	W02	29-Sep-14	33.3	44.3	NR	<1	<1	5.9	9	9.1	1.3	10.6	9.2
C	W03	06-Oct-14	28.2	31.8	NR	<1	<1	4.2	7.4	7.6	<1	9.2	7.8
C	W04	13-Oct-14	27.7	38.5	NR	<1	<1	3.2	4.9	5.2	1.1	6.2 J	5.3
C	W05	20-Oct-14	28.0	33.9	NR	<1	<1	3	4.2	4.4	<1	4.6	4.4
C	W06	27-Oct-14	29.3	18.9	NR	<1	<1	2.9	4	6.5	R	3.5	3.3
C	W07	03-Nov-14	29.2	11.2	NR	<1	<1	1.6	2.6	2.5	<1	2.6	2.6

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.
mg/L = milligram per liter
NR = not required
OU = operable unit
R = rejected
RDEFF = Rock Drain Effluent
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Table 8. Biological Oxygen Demand, 5 day (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	NR	<2	<2	29.3	R	R	<2	77.4	53.4
C	W01	22-Sep-14	27.2	40.5	NR	<2	<2	22.1	30.3	18.8	<2	29.3	28.1
C	W02	29-Sep-14	33.3	44.3	NR	<2	<2	9.4	23.8	10.3	<2	20.3	10.9
C	W03	06-Oct-14	28.2	31.8	NR	<2	<2	7.8	15.7	9.7	<2	20.1	12.6
C	W04	13-Oct-14	27.7	38.5	NR	<2	<2	2.8	7.6	4.5	<2	16.4	17.2
C	W05	20-Oct-14	28.0	33.9	NR	<2	<2	<2	3.5	2.6	<2	10.9	15.7
C	W06	27-Oct-14	29.3	18.9	NR	<2	<2	3.1	2	<2	<2	11.5	8.4
C	W07	03-Nov-14	29.2	11.2	NR	<2	<2	2	2.6	2.3	<2	8	4.7
C	W08	10-Nov-14	27.4	14.9	NR	<2	<2	2.1	2	<2	<2	9.7	3.5

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

mg/L = milligram per liter

NR = not requrired

OU = operable unit

R = Rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

W** = Week of Treatability Study Phase

Table 9. Sulfate (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	595	579	575	603	551	571	571	497	523
C	W01	22-Sep-14	27.2	40.5	710	650	724	637	620	555 J	589	582	656
C	W02	29-Sep-14	33.3	44.3	574	615	612	605	587	565	613	573	580 J
C	W03	06-Oct-14	28.2	31.8	570	630	618	707	580	618	622	522	562
C	W04	13-Oct-14	27.7	38.5	632	637	647	660	655	648	644	615 J	612
C	W05	20-Oct-14	28.0	33.9	555	551	584	558	557	574	545	543	552
C	W06	27-Oct-14	29.3	18.9	629	614	596	625	637	673	R	602	606
C	W07	03-Nov-14	29.2	11.2	536	514	526	552	542	535	536	530	525

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.

mg/L = milligram per liter

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

W** = Week of Treatability Study Phase

Table 10. Turbidity (NTU)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	18	3	5	R	44	7	8	R	R
C	W01	22-Sep-14	27.2	40.5	18	7	4	11	49	13	4	3	13
C	W02	29-Sep-14	33.3	44.3	22	8	7	8	35	35	7	7	16
C	W03	06-Oct-14	28.2	31.8	NM	7	6	9	32	48	5	6	26
C	W04	13-Oct-14	27.7	38.5	31	8	7	14	56	47	12	7	35
C	W05	20-Oct-14	28.0	33.9	39	9	8	11	60	14	11	9	103
C	W06	27-Oct-14	29.3	18.9	38	9	6	7	33	14	5	5	38
C	W07	03-Nov-14	29.2	11.2	38	9	8	5	21	3	6	3	28
C	W08	10-Nov-14	27.4	14.9	31	5	6	2	25	0	4	5	19
C	W09	17-Nov-14	27.4	29.5	30	8	7	5	23	2	8	5	25

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
NM = not measured
NTU = Nephelometric Turbidity Units
OU = operable unit
R = Rejected
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Table 11. ORP (millivolts)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	64	151	93	-428	-296	-305	49	-444	-275
C	W01	22-Sep-14	27.2	40.5	-16	R	24	-259	-346	-277	-38	-257	-243
C	W02	29-Sep-14	33.3	44.3	-17	33	-49	-266	-272	-245	23	-265	-230
C	W03	06-Oct-14	28.2	31.8	NM	46	-26	-218	-237	-225	25	-244	-207
C	W04	13-Oct-14	27.7	38.5	32	54	-20	-192	-162	-191	-58	-226	-182
C	W05	20-Oct-14	28.0	33.9	27	65	45	-148	-51	-90	22	-180	-146
C	W06	27-Oct-14	29.3	18.9	-24	41	36	-160	-40	-60	-86	-203	-100
C	W07	03-Nov-14	29.2	11.2	27	26	34	-108	57	20	-21	-170	45
C	W08	10-Nov-14	27.4	14.9	-10	2	-29	-161	-24	-21	-43	-184	3
C	W09	17-Nov-14	27.4	29.5	26	65	61	-179	-96	-40	19	-207	-126

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
mV = millivolts
NM = not measured
ORP = Oxidation Reduction Potential
OU = operable unit
R = Rejected
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Table 12. Dissolved Oxygen (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	5.6	5.2	6.8	0.2	0.4	0.4	5.2	0.1	0.9
C	W01	22-Sep-14	27.2	40.5	6.6	2.1	6.1	0.9	0.1	1.7	3.5	1.8	3.1
C	W02	29-Sep-14	33.3	44.3	5.9	5.7	7	1.8	1.9	2.4	6.1	0.7	3.2
C	W03	06-Oct-14	28.2	31.8	NM	6.1	6.7	2.6	1.8	1.2	5.9	1.4	3
C	W04	13-Oct-14	27.7	38.5	6.1	6.4	7.2	3.1	3.7	1.8	5.9	1.5	2.9
C	W05	20-Oct-14	28.0	33.9	3.9	6.3	6	3.1	5.4	2.5	6.1	2.1	3.4
C	W06	27-Oct-14	29.3	18.9	6	6.2	6.1	3	6.2	2.3	6	2.5	4.3
C	W07	03-Nov-14	29.2	11.2	ns	6.4	7.3	3.4	6	3.7	6.7	3.1	5.1
C	W08	10-Nov-14	27.4	14.9	6.1	6.2	7	3.6	5.6	2.5	6	1.9	2.5
C	W09	17-Nov-14	27.4	29.5	5.5	6.2	7.3	0.3	5.2	0.2	5.6	0.5	2.8

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

mg/L = milligram per liter

NM = not measured

OU = operable unit

RDEFF = Rock Drain Effluent

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

W** = Week of Treatability Study Phase

Table 13. Total Dissolved Sulfide (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	R	R	R	R	R	R	R	R	R
C	W01	22-Sep-14	27.2	40.5	0	0	0	1.87	0.98	1.05	0.02	1.8	2.66
C	W02	29-Sep-14	33.3	44.3	NM	0.12	0.25	3.03	3.13	2.2	0.11	7.99	1.43
C	W03	06-Oct-14	28.2	31.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W04	13-Oct-14	27.7	38.5	0	0.02	0.06	51.46	4.9	2.5	0.07	R	3.67
C	W05	20-Oct-14	28.0	33.9	0.11	0.03	0.11	20.82	0.61	0.51	0.24	114.7	1.37
C	W06	27-Oct-14	29.3	18.9	0	1.77	0.56	69.24	0.05	0.09	1.88	R	3.07
C	W07	03-Nov-14	29.2	11.2	0.02	0.36	1.19	54.32	1.16	0.47	0.34	61.11	0.53
C	W08	10-Nov-14	27.4	14.9	NM	NM	NM	NM	NM	NM	0.14	434.4	0.48
C	W09	17-Nov-14	27.4	29.5	0	0.63	0.67	99.72	0.89	0.22	0.19	98.46	0.97

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
NM = not measured
mg/L = milligram per liter
OU = operable unit
R = Rejected
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Table 14. Temperature (degrees Celcius)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H (gpm)	FLOW V (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	20.3	20.4	18.8	18.1	18.8	14.7	16.2	12.9	18.6	18.8	16.4
C	W01	22-Sep-14	27.2	40.5	20.1	19.1	19.3	17.9	19.1	17.2	19.2	18.3	18
C	W02	29-Sep-14	33.3	44.3	16.8	15.5	16.4	14.4	13.2	12.1	15.3	13.5	13.2
C	W03	06-Oct-14	28.2	31.8	NM	15.9	14	13.2	13.3	12.5	15.5	15.3	15.3
C	W04	13-Oct-14	27.7	38.5	18.7	17.4	18.3	15.5	15.5	18	17.5	17.5	19.4
C	W05	20-Oct-14	28.0	33.9	19.6	17.7	18.2	17.1	15.3	15.2	18	18.3	17.3
C	W06	27-Oct-14	29.3	18.9	18.8	17.7	17.5	15.3	15.4	12.1	18.3	17.3	17.5
C	W07	03-Nov-14	29.2	11.2	19.1	17.7	18.1	14.1	14.8	12.4	16.5	16.5	15.7
C	W08	10-Nov-14	27.4	14.9	15.7	15.9	15.7	13.3	13.1	11.3	15.1	14.7	14.9
C	W09	17-Nov-14	27.4	29.5	18.7	14.9	12.1	11.7	10.5	9.8	16.8	14.7	14.4

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
DEG C = degrees celcius
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
NM = not measured
OU = operable unit
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Table 15. Mass Removal
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC2EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
C	W00	15-Sep-14	Cadmium, Dissolved	19.6	<0.5	19.6	20.3	204,700	100	2.2	<0.5	19.6	20.4	205,400	100	2.2
C	W01	22-Sep-14	Cadmium, Dissolved	20.2	<0.5	20.2	27.2	274,300	100	3	<0.5	20.2	40.5	407,800	100	4.5
C	W02	29-Sep-14	Cadmium, Dissolved	22.5	<0.5	22.5	33.3	336,000	100	4.1	<0.5	22.5	44.3	446,900	100	5.4
C	W03	06-Oct-14	Cadmium, Dissolved	22.3	<0.5	22.3	28.2	283,900	100	3.4	<0.5	22.3	31.8	320,400	100	3.9
C	W04	13-Oct-14	Cadmium, Dissolved	23	<0.5	23	27.7	278,900	100	3.5	<0.5	23	38.5	387,700	100	4.8
C	W05	20-Oct-14	Cadmium, Dissolved	23.4	<0.5	23.4	28.0	282,600	100	3.6	<0.5	23.4	33.9	341,500	100	4.3
C	W06	27-Oct-14	Cadmium, Dissolved	22.7	<0.5	22.7	29.3	295,100	100	3.6	<0.5	22.7	18.9	190,900	100	2.3
C	W07	03-Nov-14	Cadmium, Dissolved	20.4	<0.5	20.4	29.2	294,400	100	3.2	<0.5	20.4	11.2	112,800	100	1.2
C	W00	15-Sep-14	Iron	4500	250	4250	20.3	204,700	94.4	470.3	246	4254	20.4	205,400	94.5	473
C	W01	22-Sep-14	Iron	3740	170	3570	27.2	274,300	95.5	529.3	218	3522	40.5	407,800	94.2	777.5
C	W02	29-Sep-14	Iron	4230	129	4101	33.3	336,000	97	744.4	210	4020	44.3	446,900	95	970.7
C	W03	06-Oct-14	Iron	3940	134	3806	28.2	283,900	96.6	585	165	3775	31.8	320,400	95.8	654.4
C	W04	13-Oct-14	Iron	3820	144	3676	27.7	278,900	96.2	555	154	3666	38.5	387,700	96	769.4
C	W05	20-Oct-14	Iron	5730	326	5404	28.0	282,600	94.3	824.8	143	5587	33.9	341,500	97.5	1032.4
C	W06	27-Oct-14	Iron	24100	1340	22760	29.3	295,100	94.4	3635.1	137	23963	18.9	190,900	99.4	2468.8
C	W07	03-Nov-14	Iron	4550	297	4253	29.2	294,400	93.5	676.9	153	4397	11.2	112,800	96.6	268.4
C	W00	15-Sep-14	Iron, Dissolved	772	76.2	695.8	20.3	204,700	90.1	77	174	598	20.4	205,400	77.5	66.5
C	W01	22-Sep-14	Iron, Dissolved	723	<50	723	27.2	274,300	100	107.2	128	595	40.5	407,800	82.3	131.4
C	W02	29-Sep-14	Iron, Dissolved	1320	<50	1320	33.3	336,000	100	239.6	147	1173	44.3	446,900	88.9	283.3
C	W03	06-Oct-14	Iron, Dissolved	625	53.3	571.7	28.2	283,900	91.5	87.9	86.2	538.8	31.8	320,400	86.2	93.4
C	W04	13-Oct-14	Iron, Dissolved	339	66.1	272.9	27.7	278,900	80.5	41.2	89.4	249.6	38.5	387,700	73.6	52.4
C	W05	20-Oct-14	Iron, Dissolved	575	195	380	28.0	282,600	66.1	58	106	469	33.9	341,500	81.6	86.7
C	W06	27-Oct-14	Iron, Dissolved	1930	847	1083	29.3	295,100	56.1	173	113	1817	18.9	190,900	94.1	187.2
C	W07	03-Nov-14	Iron, Dissolved	483	148	335	29.2	294,400	69.4	53.3	106	377	11.2	112,800	78.1	23
C	W00	15-Sep-14	Manganese, Dissolved	2080	1760	320	20.3	204,700	15.4	35.4	1700	380	20.4	205,400	18.3	42.3
C	W01	22-Sep-14	Manganese, Dissolved	2160 J	1620	540	27.2	274,300	25	80.1	1970	190	40.5	407,800	8.8	41.9
C	W02	29-Sep-14	Manganese, Dissolved	2200	1500	700	33.3	336,000	31.8	127.1	2110	90	44.3	446,900	4.1	21.7
C	W03	06-Oct-14	Manganese, Dissolved	2260	1750 J	510	28.2	283,900	22.6	78.4	2160	100	31.8	320,400	4.4	17.3
C	W04	13-Oct-14	Manganese, Dissolved	2310 B	1970 B	340	27.7	278,900	14.7	51.3	2040 B	270	38.5	387,700	11.7	56.7
C	W05	20-Oct-14	Manganese, Dissolved	2270	2030	240	28.0	282,600	10.6	36.6	1820	450	33.9	341,500	19.8	83.2
C	W06	27-Oct-14	Manganese, Dissolved	2220	1650 J	570	29.3	295,100	25.7	91	1520	700	18.9	190,900	31.5	72.1
C	W07	03-Nov-14	Manganese, Dissolved	2250	594	1656	29.2	294,400	73.6	263.6	1750 J	500	11.2	112,800	22.2	30.5
C	W00	15-Sep-14	Zinc, Dissolved	3500	62.5	3437.5	20.3	204,700	98.2	380.4	148	3352	20.4	205,400	95.8	372.7
C	W01	22-Sep-14	Zinc, Dissolved	3800 J	30	3770	27.2	274,300	99.2	559	<10	3800	40.5	407,800	100	838.9
C	W02	29-Sep-14	Zinc, Dissolved	4000	<10	4000	33.3	336,000	100	726.1	279	3721	44.3	446,900	93	898.5
C	W03	06-Oct-14	Zinc, Dissolved	3970	102	3868	28.2	283,900	97.4	594.6	<10	3970	31.8	320,400	100	688.2
C	W04	13-Oct-14	Zinc, Dissolved	4000	53	3947	27.7	278,900	98.7	596	59.4	3940.6	38.5	387,700	98.5	827
C	W05	20-Oct-14	Zinc, Dissolved	4160	69.3	4090.7	28.0	282,600	98.3	624.4	65.7	4094.3	33.9	341,500	98.4	756.6
C	W06	27-Oct-14	Zinc, Dissolved	4120	47.9	4072.1	29.3	295,100	98.8	650.4	46.9	4073.1	18.9	190,900	98.9	419.6
C	W07	03-Nov-14	Zinc, Dissolved	3790	54	3736	29.2	294,400	98.6	594.7	91.7	3698.3	11.2	112,800	97.6	225.8

NOTES:
Non detects are reported as <RL and estimated as zero for calculations and graphing.
% = percent
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
B = Laboratory flag indicating blank contamination
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
g/day = grams per day
gpm = gallons per minute
H = horizontal

H Δ CONC = horizontal change in concentration
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.
MDL = method detection limit
OU = operable unit
ppm = parts per million
RDEFF = Rock Drain Effluent
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
V = vertical
V Δ CONC = vertical change in concentration
W** = Week of Treatability Study Phase

Non detects are reported as <RL and estimated as 1/2 MDL for calculations and graphing

Table 16. Hydrogen Sulfide Gas (ppm)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

			H2S-01 (Aeration Channel Inlet)			H2S-02 (Access Road near Aeration Channel-South)			H2S-03 (Access Road near Aeration Channel-North)			H2S-04 (Access Road near Biotreatment Cell)			H2S-05 (Aeration Cascade Inlet)		
Phase	**Week**	**Week of**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**
C	W00	15-Sep-14	0.033	0	1.1	0.018	0	1.5	0.0024	0	0.2	0.000	0	0	0.002	0	0.4
C	W01	22-Sep-14	0.016	0	0.7	0.025	0	1	0.0000	0	0	0.000	0	0	0.003	0	0.4
C	W02	29-Sep-14	0.032	0	1.7	0.003	0	0.5	0.0000	0	0	0.007	0	1.1	0.004	0	0.7
C	W03	06-Oct-14	0.022	0	3	0.002	0	0.4	0.0000	0	0	0.004	0	0.7	0.006	0	0.6
C	W04	13-Oct-14	0.005	0	0.5	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W05	20-Oct-14	0.005	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W06	27-Oct-14	0.008	0	0.6	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W07	03-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W08	10-Nov-14	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W09	17-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0

NOTES:
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
OU = operable unit
ppm = parts per million
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Horizontal Wetland Treatment Train Summary

NOV 2014

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

HSSF Wetland Train Report for November 2014

Settling Basin

Settling Basin No. 1 is performing as expected under design flows. Turbidity decreased from an average influent level of 38.0 NTU to an average effluent level of 8.3 NTU. Temperature decreased from an average influent level of 18.9 °C to an average effluent level of 17.3 °C. All other field parameters essentially remained unchanged.

On October 27-28, total iron concentrations decreased from an influent of 24,100 µg/L to an effluent concentration of 1,630 µg/L. Dissolved iron concentrations also decreased from an influent of 1,630 µg/L to an effluent concentration of 252 µg/L. This decrease in Total Iron concentrations represents a 93% removal rate. Most metal concentrations were unchanged during that time. Dissolved copper concentrations in the influent decreased from 304 µg/L to an effluent concentration of 17.2 µg/L, while zinc concentrations decreased from 5,460 to 3,860 µg/L. Manganese concentrations were unchanged.

SF Wetland

The SF Wetland is performing as expected under design flows. Turbidity decreased slightly in the surface wetland, from an average influent level of 8.25 NTU to an average effluent level of 6.25 NTU. Dissolved oxygen concentrations increased slightly from an average influent level of 6.4 mg/L to an average effluent level of 7.0 mg/L. Temperature decreased very slightly from an average influent level of 17.3 °C to an average effluent level of 17.0 °C.

Total iron concentrations decreased slightly from an influent concentration of 1,630 µg/L to an effluent concentration of 1,330 µg/L. None of the other metals of concern decreased significantly in the surface wetland.

The plants within the SF Wetland are now established and have gone dormant for the winter.

HSSF Wetland

The HSSF Wetland has been operated as designed during this time period, as plants became established and water elevation was no longer kept high. This resulted in a marked increase in ORP, from approximately -250 mV (September) to approximately -130 mV (end of October). Alternatively, the change in ORP could have resulted from the exhaustion of labile soluble organic matter, but this is less likely. As noted earlier, ORP was not uniform within the wetland: inlet values are typically higher than mid-point values by 40-70 mV, while mid-point ORP are higher than outlet values by 20-50 mV.

The wetland effluent temperature averaged 14.2 °C, a 3.1 °C decrease from surface wetland effluent temperatures of 17.3 °C.

Both cadmium and zinc total concentrations decreased in the HSSF wetland, from average influent concentrations of 23.1 µg/L and 3,744 µg/L to average effluent concentrations of 3.87 µg/L and 1,219 µg/L, respectively. The removal rates were 83% and 67% for Total Cadmium and Total Zinc, respectively.

Dissolved cadmium concentrations were below detection limits in the wetland effluent, while zinc concentration averaged 111 µg/L, corresponding to >95% removal rates. As noted earlier, the difference between Total and Dissolved concentrations reflects the presence of colloidal sulfides in the wetland effluent.

Manganese concentrations decreased slightly, from average influent concentrations of 2,300 µg/L to an average effluent concentration of 2,065 µg/L, which represents 10% removal (compared to 14% previously).

Aeration Channel

The aeration channel has begun to function as designed after aerators were installed in October. ORP levels have increased to approximately 50 mV and dissolved oxygen levels have remained around 6.0 mg/L since their installation. Temperature is essentially unchanged in this system. Water pH increased by 0.4 units in the aeration channel effluent, averaging 7.4 compared with 7.0 in the HSSF wetland effluents. This increase has been consistently observed during the study and probably reflects the consumption of proton acidity that occurs when sulfide is oxidized.

Turbidity continues to be a problem with the aeration channel, despite a significant decrease since the previous report. Its effluent contained an average level of 25.5 NTU, a 43% decrease from the last reporting period, compared with an average influent levels of 6 NTU.

Concentration of the metals of concerns decreased slightly in the aeration channel. During this reporting period, total cadmium concentrations in the influent decreased from 3.8 µg/L to 2.8 µg/L, while zinc concentrations decreased from 1,090 to 873 µg/L. Dissolved cadmium concentrations were below detection limits in both influent and effluent, while dissolved zinc concentrations decreased from 79.9 µg/L to 47.8 µg/L. Manganese concentrations remained unchanged.

Thus, it appears that the aeration channel provides additional removal of colloidal metal sulfides.

Rock Drain

The rock drain has been sampled extensively since the last report, in an effort to restore its proper function. Samples were collected at depth near the inlet, mid-point and outlet to determine ambient conditions (pH, ORP, and manganese concentrations). These were compared with inlet and outlet parameters to determine the effectiveness of remedial measures. Unfortunately, for this reporting period, we only have data that track improvements from installing aerators in the aeration channel.

ORP is the most telling parameter of improved conditions because oxidative conditions (i.e., ORP > 50-100 mV) are required for manganese removal. Table 1 shows the change in ORP in the rock drain after the aerators were installed (Week 4). The ORP throughout the system is seen to remain below -100 mV through Weeks 5 and 6. There were signs of improvement on Week 7, as ORP near the inlet and at the mid-point increased near or above 0 mV, while ORP near the outlet increased by 150 mV since Week 5.

Table 1. ORP measurements at selected locations in the Rock Drain.

LOCATION	Week 5	Week 6	Week 7
Inlet	-69	-32.5	55
Near-inlet	-116	-108	-8
Mid-point	-123	-47	38.5
Near-outlet	-194	-141	-43
Outlet	-101	-53	44.5

The rock drain was drained on November 12 and 13th in an effort to remove the low ORP water and see a quicker change in higher ORP was with higher dissolved oxygen from the aeration channel. Initial results look promising and we expect to see much better results from the rock drain next reporting period.

Field observations indicated that rock collected at the surface of the drain, where atmospheric oxygen can readily exchange at the water surface, had manganese oxide deposits. This means that manganese oxidizing bacteria will colonize the rock drain where conditions are favorable.

From the last week of September onwards, rock drain effluent was dark and contained suspended solids. During that time, turbidity remained elevated, from average influent levels of 44.9 NTU to average effluent levels of 42 NTU.

Rock drain effluent temperature averaged 13.6 °C, a 1.0 °C decrease from average aeration channel effluent temperatures.

Conclusions – HSSF Treatment Train

The performance of the HSSF treatment train has been hampered by the need to keep water levels high so that plants can become established. This had a cascading effect, whereby excessively high sulfide levels produced in the HSSF wetland prevented the proper function of the aeration channel and rock drain. This is expected to change in December as water levels are lowered and design HRT are achieved in the HSSF wetland. Additionally, the aeration channel appears to be functioning as designed after the installation of aerators, resulting in full removal of sulfides and re-oxygenation of mine water. The rock drain is expected to begin removing manganese now the anoxic, sulfidic water has been removed from the drain and manganese oxidizers become established.

Vertical Wetland Treatment Train Summary

NOV 2014

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Rico Vertical Wetland Treatment Train Report for November 2014

Settling Basin No. 2

Settling Basin No. 2 (SB No. 2) continued performing as expected. Turbidity decreased from an average influent level of 38 NTU to an average effluent level of 5.1 NTU. Temperature decreased from an average influent level of 18.6 °C to an average effluent level of 15.8 °C. No significant changes were observed in any other field parameters.

With the exception of manganese and nickel, influent total metals concentrations increased markedly in October 27 sampling results compared to concentrations observed in previous sampling results from October. Total aluminum concentrations increased from an average concentration of 343 µg/L to 2,190 µg/L. Total arsenic concentrations increased from an average concentration of <1.0 µg/L to 1.5 µg/L. Total cadmium concentrations increased from an average concentration of 23 µg/L to 31.5 µg/L. Total iron concentrations increased from an average concentration of 4,430 µg/L to 24,100 µg/L. Total copper concentrations increased from an average concentration of 57 µg/L to 304 µg/L. Total lead concentrations increased from an average concentration of 4 µg/L to 15.9 µg/L. Total zinc concentrations increased from an average concentration of 4,103 µg/L to 5,460 µg/L.

Total metals concentrations in SB No. 2 effluent on October 27 were unchanged compared to previous sampling results from October, indicating that SB No.2 has a significant safety margin for particulate metals removal.

Biotreatment Cell

As measured at water quality sonde 08 (WQ08), in November dissolved oxygen levels averaged 0.17 mg/L and ORP averaged -398 mV. ORP and DO measurements recorded by WQ08 are significantly lower than field parameters recorded during sampling events. Biotreatment cell effluent temperature averaged 15.56 °C, a 0.24 °C decrease from the average SB No. 2 effluent temperature of 15.8 °C.

Total cadmium concentrations decreased from an average influent concentration of 22.2 µg/L to an average effluent concentration of 0.7 µg/L. Total zinc concentrations decreased from an average influent concentration of 3,784 µg/L to an average effluent concentration of 759 µg/L. Total manganese concentrations decreased from an average influent concentration of 2,284 µg/L to an average effluent concentration of 1,960 µg/L.

Dissolved cadmium concentrations decreased from an average influent concentration of 22.3 µg/L to below laboratory detection limits. Dissolved zinc concentrations decreased from an average influent concentration of 3,620 µg/L to an average effluent concentration of 44 µg/L.

Dissolved manganese concentrations decreased from an average influent concentration of 2,268 µg/L to an average effluent concentration of 1,934 µg/L.

Aeration Cascade

As measured at water quality sonde 09 (WQ09), in November dissolved oxygen levels averaged 2.45 mg/L and ORP averaged -103 mV. ORP and DO measurements recorded by WQ09 are significantly lower than field parameters recorded during sampling events. Aeration cascade effluent temperature averaged 14.86 °C, a 0.7 °C decrease from the average biotreatment cell effluent temperature of 15.56 °C. pH increased from an average influent level of 6.70 S.U. to an average effluent level of 6.86 S.U.. Turbidity increased from an average influent level of 5.8 NTU to an average effluent level of 40.1 NTU. Increases in turbidity are the result of sulfide oxidizing to elemental sulfur.

Total cadmium, manganese and zinc concentrations were unchanged from the average influent concentrations.

Dissolved cadmium and manganese concentrations were unchanged from the average influent concentrations. Dissolved zinc concentrations increased from an average influent concentration of 44 µg/L to an average effluent concentration of 112.8 µg/L.

Effluent sulfide concentrations averaged 3.4 mg/L (influent sulfide data has been determined to be unreliable). BOD concentrations decreased from an average influent concentration of 13.4 mg/L to an average effluent concentration of 11.7 mg/L.

Conclusions and Planned Activities– Vertical Wetland Treatment Train

VWTT metals removal performance was within design expectations at design flow rates. Biotreatment cell effluent BOD and total organic carbon concentrations have continued to decrease during November. During October and early November, the biotreatment cell was more strongly anaerobic than is considered ideal and was generating excessive levels of effluent sulfide. Operational adjustments (flow rate and water levels) were performed during November with the goal of raising biotreatment cell effluent ORP to between -400 mV and -350 mV (as measured at WQ08). The operational adjustments increased the biotreatment cell effluent ORP to approximately -400 mV. Additionally, the WQ08 sonde may have been reporting artificially low readings due to sensor drift. Following a sensor calibration on November 25, WQ08 ORP readings increased from approximately -400 mV to -370 mV and have remained stable at approximately -370 mV since that time.

Replacement of the limestone rock in the aeration cascade with HDPE trickling filter media (http://www.wardenbiomedia.com/products/bioball.htm) is planned for the week of December 8. The HDPE trickling filter media installation will increase the surface area available for growth

of sulfide-oxidizing bacteria, and increase the HRT of the aeration cascade due to the higher porosity of the material. These two factors are expected to significantly increase the performance of the aeration cascade.

Wetland Plant Update

NOV 2014

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

November 2014 Monitoring

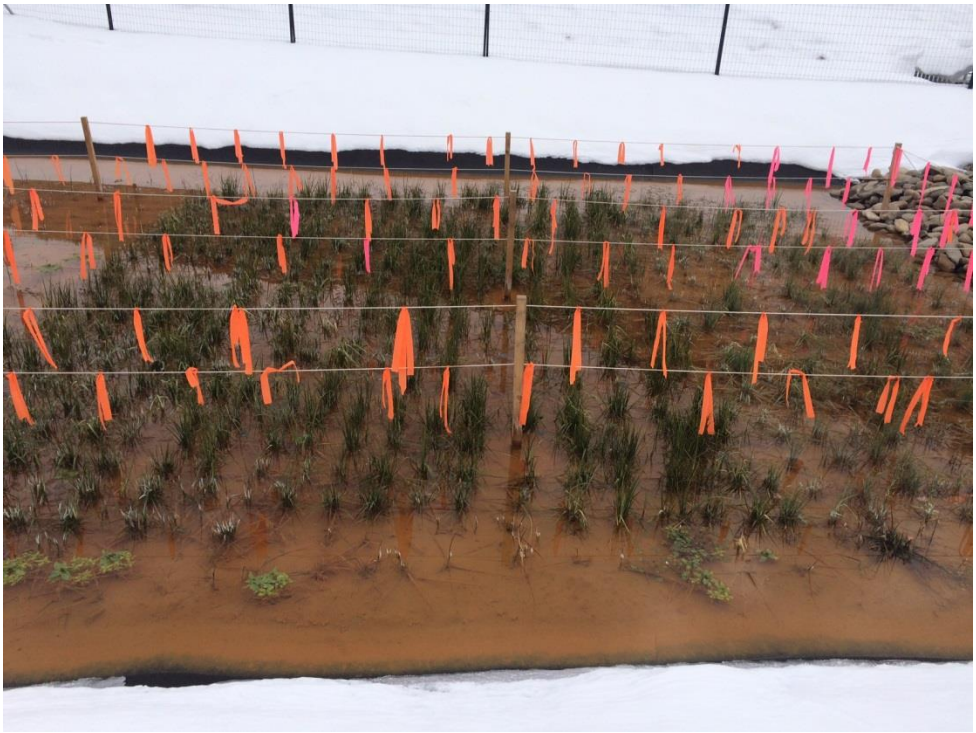
Photograph 1: SF Wetland with Planted Bulrush, Sedge, and Rush – Looking South on November 6, 2014

Photograph 2: SF Wetland – Looking South on November 20, 2014

Photograph 3: SF Wetland with Bulrush, Sedge, and Rush – Looking West on November 6, 2014

Photograph 4: SF Wetland– Looking West on November 20, 2014

Photograph 5: SF Wetland Looking Southeast on November 6, 2014



Photograph 6: SF Wetland Looking East on November 20, 2014

Photograph 7: HSSF Wetland with Establishing Wetland Plants – Looking South on November 6, 2014

Photograph 8: HSSF Wetland – Looking South on November 20, 2014

Photograph 9: HSSF Wetland with Establishing Sedge and Rush on November 6, 2014

Photograph 10: HSSF Wetland Soil Side-strip – Seeded Area with Planted Sedge and Rush in Background Looking East on November 6, 2014

Photograph 11: HSSF Wetland Sedge Plant - Soil Pit - on November 6, 2014

Photograph 11: HSSF Wetland Sedge Plant - Soil Pit - on November 6, 2014